**DYNAMIC IN VITRO COMPARISON OF TIBIOFEMORAL CONTACT STRESS AFTER TKA WITH FIXED AND MOBILE BEARING INLAY**

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**Introduction**

Recent knee prosthesis designs include movable polyethylene inlays, known as mobile bearing. These systems are intended to allow higher conformity of the tibiofemoral joint than in fixed inlays and thereby decrease contact stress without decreasing the knee’s range of motion. Decreased contact stress is postulated to lead to increased longevity of the polyethylene bearing inlay. Several authors have reported a significantly lower contact stress on the polyethylene inlay in quasi-static studies, recording or calculating the contact stress in sequential steps of different knee flexion angles.

The study’s purpose was to compare the tibiofemoral contact stress and bearing contact area of fixed and mobile bearing inlays under dynamic loading.

**Material and Methods**

The Interax System™ was implanted into the right knee of 5 fresh frozen specimens. The Interax System offers three different inlay types that fit to one femoral component (Standard, High Conformity, Meniscal Bearing).

The specimens were mounted in a knee simulator for biomechanical testing. The quadriceps tendon was attached via clamp and cable to a hydraulic cylinder, which applied a simulated extending quadriceps force. The test mimicks both the speed and resulting moment of a lower limb isokinetic extension test in a range of tibial motion from 120° flexion to full extension. The quadriceps cylinder provides a constant torque on the lower limb of 39 Nm while realizing forces up to 1800 N.

The tibofemoral peak contact stress and the tibiofemoral bearing area were measured using resistive ink, 0.1-mm-thin pressure sensors (Tekscan, Boston), measuring 572 points per compartment at 10 Hz.

**Results**

Average maximum peak contact stress was 35 MPa (+/-20 MPa) for the Standard, 12 MPa (+/-5 MPa) for the High Conformity, and 10 MPa (+/-5 MPa) for the Meniscal Bearing inlay. Slightly higher peak contact stress was measured in the lateral than in the medial compartment. Contact stress through the range of knee flexion angle differed most for the standard inlay, with its maximum at 70°. Contact stress on the Meniscal Bearing inlay was consistently lower than that of the fixed bearing inlays and did not vary with knee flexion angle. Maximum bearing contact area was 65 mm² for the Standard, 120 mm² for the High Conformity, and 140 mm² for the Meniscal Bearing inlay. Location of bearing area for the Standard inlay showed the most movement during knee flexion, whereas the Meniscal Bearing inlay bearing location remained fairly constant.

**Discussion**

This study shows a significantly lower tibiofemoral contact stress with the Meniscal Bearing inlay under dynamic conditions compared to Standard and High Conformity inlays. Since the Meniscal Bearing inlay peak contact stress does not exceed 12 MPa, the maximum contact stress of UHMWPE is not reached. These findings correlate to studies made with the LCS mobile bearing inlay, which also shows a sub-failure contact stress on the polyethylene inlay with a high bearing area. The ability to translate on the tibia baseplate allows the inlay to align its position to the femoral component to maximize contact area. This feature reduces the likelihood of cold flow and stress-peak damage and supports the longevity of the prosthesis.